# SPECIFICATION

TO ALL WHOM IT MAY CONCERN:

BE IT KNOWN THAT I, STEPHAN PRESTEL, of Frühlingsstraße 25, D-76287 Rheinstetten-Mörsch, Federal Republic of Germany, a German citizen, have invented certain new and useful improvements in a SURGICAL INSTRUMENT of which the following is a specification:

## BACKGROUND OF THE INVENTION

The invention relates to a surgical instrument with a tool which is located at the distal instrument end, with a stationary first grip part at the proximal instrument end, with an axially guided second grip part in the form of a reel, and with an actuation element for the tool, wherein the actuation element in connection with the second grip part is axially adjustable on adjustment of the second grip part.

A surgical instrument of the known type is known from DE 84 15 222 U1. Here a forceps at the distal end of the instrument is actuated in that by the surgeon a displacement movement between an axially fixed grip part and a reel is carried out. This displacement movement is transmitted via a wire led in a sleeve to the forceps which then is correspondingly closed or opened.

A similar design has the surgical gripping element known from DE 30 12 447 A1. Also here a wire led in a sleeve transmits an axial displacement movement of a reel relative to the stationary grip to the tool. The wire is connected to the stationary grip and the reel to the actuation-side end of the sleeve, wherein the latter mentioned connection is created via a direction-reversal gearing.

With the known instruments, in particular with the application of smaller forceps it is disadvantageous that on account of the comparitively small displacement path of the reel relative to the stationary grip, a fine-touch actuation of the forceps jaw or a scissors arranged in place of the forceps is not possible. This is caused on account of the relatively short jaw

part limbs and connecting rod on which the pull wire engages with its distal end and whose proximal end is connected to the reel.

## BRIEF SUMMARY OF THE INVENTION

It is therefore the object of the present invention to develop further a surgical instrument of the known type such that the handling of the instrument is improved and a more fine-touch actuation of the instrument is possible. In particular with the application of smaller forceps it is to be possible to ensure a fine-touch actuation of the forceps jaw which inspite of this is accurate.

The solution of this object by way of the invention is characterized in that by way of a lever system linked onto the second grip part and a stationary part of the instrument the adjustment path is geared down and the force exerted onto the reel is transmittable, geared up, to the actuation element.

The lever system may consist of two levers. With this in an advantageous manner the one first lever with its one end is articulately arranged on the second grip part and with its other end is articulately arranged on the other second lever, the second lever with its one end is articulately arranged on the first lever and with its other end is articulately arranged on the stationary part of the instrument and finally the actuation element is articulately fastened between the two linkage points of the second lever.

Alternatively to this, the lever system may also consist of a single lever. With this the lever with its one end is articulately arranged on the stationary part of the instrument and with its other end is slidingly arranged in a guide of the second grip part, and the actuation element is articulately fastened between the two ends of the lever to this lever. The guide at the same time comprises a bore which extends essentially perpendicular

to the movement direction of the actuation element, it can in particular consist of a cylindrically formed section and a conically formed section connecting to this lever.

As an overload protection between the lever system and the actuation element there may be arranged a spring element.

## BRIEF DESCRIPTION OF THE DRAWINGS

In the drawing there is shown one embodiment example of the invention. There are shown in:

Fig. 1 a surgical instrument with a closed tool,

Fig. 2 a view of the surgical instrument with an opened tool, corresponding to the representation according to Figure 1,

Fig. 3 a cutout of the instrument with a reel as a second grip part and lever system,

Fig. 4 an embodiment form of the lever system alternative to Fig. 3,

Fig. 5 a further embodiment with a spring element.

## DETAILED DESCRIPTION OF THE INVENTION

In Fig. 1 there is to be seen the surgical instrument 1 which at its distal end comprises a tool 2. The tool 2 is here formed as a forceps. It has a forceps jaw with two jaw parts which are pivotable towards one another

by actuation of the instrument 1, for opening and closing the forceps jaw, as will later be described in more detail. Alternatively - but not shown - the tool may also be designed as a scissors in order to cut tissue.

The instrument 1 comprises a first, stationarily arranged grip part 3 in the form of a ring which is gripped through by the thumb by the surgeon. A second grip part 4 is axially adjustable relative to the first grip part 3 and is formed as a reel which is gripped between the index finger and the middle finger and which permits a particularly simple handling.

With an axial displacement of the reel 4 relative to stationary grip part there is effected an axial displacement of an actuation element 5 which is formed as a rod and which in its continuation in the direction of the distal end of the instrument 1 merges into a wire 16. The wire 16 is guided in a sleeve 17 according to the principle of a Bowden cable wherein the sleeve 17 may be designed as a wire coil and the distal wire end in the known manner is connected to the tool.

The actuation element 5 at its proximal end proximal to the first grip part 3 is articulately in connection with a lever system. This lever system consists in the case of the formation according to the Figures 1, 2, 3 and 5 of two levers 7 and 8. The one first lever 7 is with its one end linked to a first linkage point 9 on the reel 4; its other end is connected to a linkage point 10 to the other second lever 8. The latter is in turn at the linkage point 11 connected to a stationary part of the instrument 1, in the present case on the inner circumference of the tube 6 on which the reel is guided.

The manner of functioning resulting from this design is also clear with a comparison of Fig. 1 and 2. The two Figures are arranged amongst one another such that the instrument with its parts 3, 6 and 11 are located in the same axial position. According to Fig. 1 the reel 4 in comparison to Fig. 2 is pulled to the right or proximally so that the tool 2 is closed. For opening the tool 2 the reel 4 is displaced distally on the tube 6, and specifically into

the position according to Fig. 2 in which the tool 2 is opened. With these procedures the position of the linkage point 11 is maintained whilst all other joints or linkage points and also the two levers 7 and 8 assume changing positions according to the representations, wherein according to the movement direction of the reel 4 the actuation 5 is adjusted axially distally or proximally for opening and closing the tool 2.

As furthermore results from a comparison of the two Figures the reel with the movement from its exteme position to the left - tool opened - displaced into its extreme right position - tool 2 closed - is displaced by the path X. As a result of the selected geometry of the lever system 7 and 8 as well as the linked arrangement of the actuation element 5 between the two linkage points 10 and 11 in the specific embodiment example it results that the actuation element 5 is displaced merely by the path Y. This means that on the one hand the displacement path of the actuation element 5 in relation to that of the reel 4 is geared down and on the other hand the forces which are exerted onto the reel 4 are geared up in relation to the actuation force of the actuation element 5.

Accordingly with the instrument put forward it is possible to achieve a fine-touch actuation of the tool 2 and inspite of this it is possible to exert relatively large forces onto the actuation element on closing the tool.

Figure 4 shows a lever system which only consists of a single lever 7'. The lever 7' is with its one end articulately fastened to the stationary part 6 of the instrument. Its other end is formed as a ball-like head and is arranged in a guide 12 which is incorporated into the reel 4. The guide 12 at the same time in its upper part consists of a cylindrical section 13 which in the lower part blends into a spherical section 14. On displacement of the reel 4 relative to the stationary part 6 the head-like end of the lever 7' slides in the guide 12. At the same time there results a pivoting movement of the lever 7' gripping through a slot in the tube 6. The actuation element 5

linked on between the two ends of the lever 7' is at the same time displaced correspondingly geared down.

Fig. 5 shows finally yet a further formation which may be applied with all mentioned lever systems. The actuation element 5 here is not directly arranged on the lever 8 or 7'. The connection between the lever 8 or 7' to the actuation element 5 is rather created by a spring element 15. The sping element 15 serves as an overload protection of the instrument. With this the element 15 on closing the tool which e.g. grasps tissue is loaded in tension.